

What is claimed is:

1. A method for the creation of a solder bump, comprising the steps of:

providing a semiconductor substrate, at least one contact pad having been provided on the surface of said substrate, a layer of passivation having been deposited over the surface of said substrate, said layer of passivation having at least one opening through said layer of passivation that aligns with said at least one contact pad created on the surface of said substrate, exposing the surface of said at least one contact pad;

creating a layer of Under Bump Metal (UBM) over said at least one contact pad;

electroplating a solder layer over said layer of UBM to a solder height, said solder having a top surface;

coating a layer of polyimide over the exposed surface of passivation to a polyimide thickness;

assuring that said solder height exceeds said polyimide thickness by a measurable amount, thereby assuring that said solder protrudes from the surface of said layer of polyimide, said protrusion forming a protruding layer of solder;

reflowing said protruding layer of solder, thereby creating a solder ball.

2. The method of claim 1, said at least one contact pad comprising aluminum or an aluminum alloy or copper.

3. The method of claim 1, said creating a layer of Under Bump Metal (UBM) comprising creating a layer of nickel, created to a thickness between about 1 and 10 μm , deposited by vacuum evaporation or by electroplating.

4. The method of claim 1, said creating a layer of Under Bump Metal (UBM) comprising creating a layer of chrome, followed by a layer of copper, followed by a layer of gold, created to a thickness between about 1 and 10 μm , deposited by vacuum evaporation or by electroplating.

5. The method of claim 1, said creating a layer of Under Bump Metal (UBM) comprising creating a layer multiple layers of metal.

6. The method of claim 1, said assuring that said solder height exceeds said polyimide thickness by a measurable amount comprises etching the surface of said layer of polyimide, thereby reducing said polyimide thickness such that said top surface of said electroplated solder is in a plane that is further removed from the surface of said substrate than the surface of said layer of polyimide.

7. The method of claim 1, said reflowing said protruding column of solder comprising:

applying a flux to exposed surfaces of said column of solder; and

exposing the solder in a reflow surface to elevated temperatures under a nitrogen atmosphere, forming a spherically shaped solder bump above a plane of the surface of said layer of polyimide.

8. The method of claim 1, with additional steps of creating at least one layer of metal by electroplating the exposed surface of said layer of UBM in accordance with said photoresist mask using metal as a source, said additional steps being performed prior to said step of electroplating using solder as a source the exposed surface of said layer of UBM in accordance with said photoresist mask.

9. The method of claim 1, with an additional step of performing an in-situ sputter clean of the exposed surface of said at least one the contact pad, said additional step to be performed prior to said step of depositing a layer of seed material over the surface of said layer of passivation.

10. A method for the creation of a solder bump, comprising the steps of:

providing a semiconductor substrate, at least one contact pad having been provided on the surface of said substrate, a layer of passivation having been deposited over the surface of said substrate, said layer of passivation having been patterned and etched creating at least one opening through said layer of passivation that aligns with said at least one contact pad created on the surface of said substrate, exposing the surface of said at least one contact pad;

depositing a layer of seed material over the surface of said layer of passivation, including the exposed surface of said at least one contact pad;

creating a layer of Under Bump Metal (UBM) over the surface of said layer of seed material;

creating a photoresist mask over the surface of said layer of UBM, said photoresist mask having at least one opening that aligns with said at least one contact pad, exposing the surface of said layer of UBM;

electroplating the exposed surface of said layer of UBM in accordance with said photoresist mask using solder as a source, filling said at least one opening created in said photoresist mask with solder to a solder height, said solder having a top surface;

removing said photoresist mask from the surface of said layer of UBM, exposing the surface of said layer of UBM;

etching the exposed surface of said layer of UBM, using said electroplated solder as a mask, exposing the surface of said layer of seed material;

etching the exposed surface of said layer of seed material, using said electroplated solder as a mask, exposing the surface of said layer of passivation;

coating a layer of polyimide over the exposed surface of passivation to a polyimide thickness, said polyimide thickness being less than said solder height by a measurable amount, thereby assuring that said solder protrudes from the surface of said layer of polyimide by said measurable amount, said protrusion forming a protruding layer of solder;

reflowing said protruding layer of solder, thereby creating a solder ball.

11. The method of claim 10, said at least one contact pad comprising aluminum or an aluminum alloy.

12. The method of claim 10, said creating a layer of Under Bump Metal (UBM) over the surface of said layer of seed material comprising creating a layer of nickel, created to a thickness

between about 1 and 10 μm , deposited by vacuum evaporation or by electroplating.

13. The method of claim 10, said creating a layer of Under Bump Metal (UBM) over the surface of said layer of seed material comprising creating a layer of chrome, followed by a layer of copper, followed by a layer of gold, created to a thickness between about 1 and 10 μm , deposited by vacuum evaporation or by electroplating.

14. The method of claim 10, said creating a layer of Under Bump Metal (UBM) over the surface of said layer of seed material comprising creating a layer multiple layers of metal.

15. The method of claim 10, with an additional step of etching the surface of said layer of polyimide, reducing said polyimide thickness, increasing said measurable amount that said solder protrudes from the surface of said layer of polyimide, said increasing said measurable amount that said solder protrudes from the surface of said layer of polyimide being determined by design requirements of solder bump size and pitch, said additional step being performed prior to said step of reflowing said protruding layer of solder.

16. The method of claim 10, said reflowing said protruding layer of solder comprising:

applying a flux to exposed surfaces of said layer of solder;
and

exposing the solder in a reflow surface to elevated temperatures under a nitrogen atmosphere, forming a spherically shaped solder bump above the plane of the surface of said layer of polyimide.

17. The method of claim 10, with additional steps of creating at least one layer of metal by electroplating the exposed surface of said layer of UBM in accordance with said photoresist mask using metal as a source, said additional steps to be performed prior to said step of electroplating using solder as a source the exposed surface of said layer of UBM in accordance with said photoresist mask.

18. The method of claim 10, with an additional step of performing an in-situ sputter clean of the exposed surface of said at least one the contact pad, said additional step being performed prior to said step of depositing a layer of seed material over the surface of said layer of passivation.

19. A method for forming a bump on a semiconductor substrate, at least one contact pad having been provided on the surface of said semiconductor substrate, comprising the steps of:

depositing a layer of passivation over said semiconductor substrate, including the surface of said at least one contact pad;

patterning and etching said layer of passivation, creating at least one opening in said layer of passivation, exposing the surface of said at least one contact pad;

performing an in-situ sputter clean of the exposed surface of said at least one contact pad;

depositing a layer of seed material over the surface of said layer of passivation, including said exposed surface of said at least one contact pad;

plating a layer of Under Bump Metallurgy (UBM) over the surface of said layer of seed material;

creating a photoresist mask over the surface of said layer of UBM, a pattern of at least one opening of said photoresist mask being aligned with said at least one contact pad provided on the surface of said substrate, exposing the surface of said layer of UBM;

electroplating the exposed surface of said layer of UBM using solder as a source, forming a pattern of at least one layer of solder aligned with said at least one contact pad provided on

the surface of said substrate, said at least one layer of solder having a top surface, said at least one layer of solder having a solder height;

removing said photoresist mask from the surface of said layer of UBM;

etching said layer of UBM and said layer of seed material, using said pattern of said at least one layer of solder as a mask, exposing the surface of said layer of passivation;

coating a layer of polyimide over the exposed surface of said layer of passivation to a thickness such that the top surface of said at least one layer of solder is in a plane above the surface of said coated layer of polyimide;

applying a solder flux or paste to the top surface of said at least one layer of solder; and

reflowing the surface of said at least one layer of solder, forming at least one solder bump aligned with said at least one contact pad.

20. The method of claim 19 with an additional step of curing said photoresist, said additional step to be performed after said photoresist has been deposited and before said layer of photoresist is patterned and developed for the creation of said photoresist mask.

21. The method of claim 20 wherein said curing said layer of photoresist is performed in a N₂ gas ambient, at a temperature of between about 300 and 400 degrees C., for a time period between about 1.5 and 2.5 hours, and a pressure of 760 Torr.

22. The method of claim 19, said layer of Under Bump Metallurgy comprising a plurality of sub-layers of different metallic composition.

23. The method of claim 19, said at least one contact pad comprising aluminum or an aluminum alloy.

24. The method of claim 19, said plating a layer of Under Bump Metallurgy (UBM) over the surface of said layer of seed material comprises creating a layer of chrome, followed by a layer of copper, followed by a layer of gold, created to a thickness between about 1 and 10 μ m, deposited by vacuum evaporation or by electroplating.

25. The method of claim 1, with additional step of creating at least one layer of metal by electroplating over the exposed surface of said layer of UBM in accordance with said photoresist mask using metal as a source, said additional step to be performed prior to said step of electroplating using solder as a

source the exposed surface of said layer of UBM in accordance with said photoresist mask.

26. The method of claim 10, with an additional step of etching the surface of said layer of polyimide, reducing said polyimide thickness, increasing by a measurable amount a difference between said solder height and the thickness of said layer of polyimide, said increasing by a measurable amount a difference between said solder height and the thickness of said layer of polyimide being determined by design requirements of solder bump size and pitch, said additional step being performed prior to said step of reflowing said protruding layer of solder.

27. At least one solder bump having been created over the surface of a semiconductor substrate, comprising:

at least one contact pad having been provided on the surface of said substrate;

a layer of passivation having been deposited over the surface of said substrate, said layer of passivation having been patterned and etched creating at least one opening through said layer of passivation that aligns with said at least one contact pad created on the surface of said substrate, exposing the surface of said at least one contact pad, said layer of passivation having an exposed surface;

at least one patterned and etched layer of seed material deposited over the surface of said layer of passivation, including the exposed surface of said at least one contact pad, said at least one layer of seed material being aligned with said at least one contact pad;

at least one patterned and etched layer of Under Bump Metal (UBM) created over the surface of said layer of seed material, said at least one layer of UBM being aligned with said at least one layer of seed material;

at least one layer of solder material having a solder height provided over the surface of said at least one layer of UBM, said at least one layer of solder being aligned with said at least one layer of UBM;

a layer of polyimide coated over the exposed surface of the layer of passivation to a polyimide thickness, said polyimide thickness being less than said solder height by a measurable amount, said solder protruding from the surface of said layer of polyimide by said measurable amount, said protrusion forming a protruding layer of solder;

said protruding layer of solder having been reflowed, thereby having created a solder ball.

28. The at least one solder bump of claim 27, said at least one contact pad comprising aluminum or an aluminum alloy.

29. The at least one solder bump of claim 27, said at least one layer of Under Bump Metal (UBM) comprising a layer of nickel, created to a thickness between about 1 and 10 μm .

30. The at least one solder bump of claim 27, said at least one layer of Under Bump Metal (UBM) comprising a layer of chrome, followed by a layer of copper, followed by a layer of gold, created to a thickness between about 1 and 10 μm .

31. The at least one solder bump of claim 27, said at least one layer of Under Bump Metal (UBM) comprising multiple layers of metal.

32. The at least one solder bump of claim 27, with additionally at least one layer of metal having been created by electroplating said at least one layer of UBM.